19. Discuss the principle of operation of silicon and germanium semiconductor detectors. Explain how charge carriers are generated and collected in response to incident radiation. What are the advantages and limitations of semiconductor detectors in radiation detection?

20. Discuss the CPT theorem and CP violation in detail. Explain.

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NOVEMBER/DECEMBER 2024

GPH32/DPH32 — NUCLEAR PHYSICS

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. What is nuclear magnetic dipole moment?

2. List the ground state properties of the deuteron.

3. Give the types of nuclear reactions.

4. What is the basic principles of Fermi's theory of beta decay?

5. What is Q-value for nuclear a nuclear reaction?

6. What is shell model of nucleus?

7. What are the advantages of using an ionization chamber in radiation detection?

8. Give the working principle of a Geiger-Muller counter.

9. What are baryons? Give two examples.

10. What is isospin?

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Write a note on P-n scattering Low energies.

Or

(b) Briefly write about the nature and properties of nuclear forces.

12. (a) Summarize Gamow's theory of alpha decay.

Or

(b) Discuss the selection rules of the gamma decay.

13. (a) Discuss the limitations of the liquid drop model in explaining certain nuclear properties, particularly those related to shell structure.

Or

(b) What are nuclear magnetic dipole moments, and how does the shell model explain them?

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14. (a) Define detection efficiency. Explain the factors that influence the detection efficiency of a radiation detector.

Or

(b) Describe the working principle of scintillation detectors. How do they convert radiation energy into detectable light, and what factors affect their performance?

15. (a) Classify the fundamental forces.

Or

(b) Derive the Gell-Mann–Nishijima formula.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Discuss the concept of Meson theory in detail.

17. Discuss Pauli's neutrino hypothesis in the context of beta decay. How did it resolve the issue of energy conservation and what experimental evidence supports the existence of the neutrino?

18. Derive the semi-empirical mass formula used in the liquid drop model. Discuss the physical significance of each term (volume, surface, Coulomb, asymmetry, and pairing). How does the formula explain the stability and binding energy of nuclei?